THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application of:	Gail M. Cunningham
Serial No.	09/841,518
Filed:	April 24, 2001
Confirmation No.:	5647
For:	FLUID-BORNE NOISE SUPPRESSION IN AN AUTOMOTIVE POWER STEERING SYSTEM
Attorney Docket No.:	5196-01 FSP
Group Art Unit:	1733

CERTIFICATE OF MAILING

I hereby certify that this paper (along with any referred to as being attached or enclosed) is being deposited with the United States Postal Service on the date shown below with sufficient postage as first class mail in an envelope addressed to: Assistant Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450

On: October 29, 2004

Diana Castillo

Diana Castillo

Assistant Commissioner for Patents
Alexandria, VA 22313-1450

Sir:

PETITION

This is a Petition for status information on the subject application and, if necessary, for reconstruction of the application file. Inasmuch as the PTO has thus far been unable to provide status information on the subject application or, apparently, to determine whether the application file is lost, it is believed that there should be no fee associated with this Petition. In the event that any fees are due, the same may be charged to Account No. 50-0852.

This application was filed on April 24, 2001 (copy of Filing Receipt enclosed).

Applicant filed a first Status Inquiry on September 23, 2002 (copy of Receipt Card enclosed). No status information was supplied by the PTO.

The Applicant filed a Second Status Inquiry on March 11, 2003 (copy of Receipt Card enclosed). Again, no status information was supplied by the PTO in response to this Second Status Inquiry.

Applicant's representative has been in contact with various PTO employees, by telephone, concerning the status of this application, from April 29, 2004 to October 26, 2004. Enclosed are copies of two pages of notes concerning these telephone calls, identifying the dates and the persons with whom the status of the application was discussed. Based upon this information, it appears that the PTO file on the present application may be "lost," at least in the sense that the file can not be located.

The application has now been on file for about three and one-half years without an Office Action having been received. It is believed and respectfully submitted that applicant is entitled to examination of his patent application.

Enclosed are complete copies of the Text, Drawings, Application Transmittal Sheet, Fee Transmittal Sheet, Request and Certification, Declaration, Power of Attorney and Information Disclosure Statement initially filed in the present application. It is hereby **certified** that these enclosed materials are true copies of the originally filed documents. (The originally filed documents also included copies of the U.S. patent documents cited in the IDS, but copies of these materials are no longer required under current practice.)

Applicant therefore respectfully petitions: (1) for an explanation of the status of the subject application, and (2) for reconstruction of the application file from the enclosed materials if necessary to begin the examination process.

Respectfully submitted,

REISING, ETHINGTON, BARNES, KISSELLE, LEARMAN & McCULLOCH, P.C.

By:_____

Robert C. Collins
Reg. No. 27,430
(248) 689-3500
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RCC/dc

Please type a plus sign (+) inside this box → [+]

PTO/SB/05 (11-00)

Approved for use through 10/31/2002. OMB 0651-0032
U.S. Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE

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UTILITY PATENT APPLICATION TRANSMITTAL

(for new nonprovisional applications under 37 C.F.R. 1.53(b))

Attorney Docket No.	5196-01 FSP
First Inventor	Gail M. Cunningham
Title	Fluid-Borne Noise Suppression in an Automotive Power Steering System
Express Mail Label No.	EL606427252US

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

ADDRESS TO: Assistant Commissioner for Patents
Box Patent Application
Washington, DC 20231

1. [X] Fee Transmittal Form (e.g., PTO/SB/17)
(Submit an original and a duplicate for fee processing)
2. [ ] Applicant claims small entity status. See 37 CFR 1.27.
3. [X] Specification [Total Pages 8]
(preferred arrangement set forth below)
- Descriptive title of the Invention
- Cross References to Related Applications
- Statement Regarding Fed sponsored R & D
- Reference to sequence listing, a table, or a computer program listing appendix
- Background of the Invention
- Brief Summary of the Invention
- Brief Description of the Drawings *(if filed)*
- Detailed Description
- Claim(s)
- Abstract of the Disclosure

4. [X] Drawing(s) (35 U.S.C.113) [Total Sheets 3]
5. Oath or Declaration [Total Pages 2]
a. [X] Newly executed (original or copy)
b. [ ] Copy from a prior application (37 CFR 1.63 (d))
(for a continuation/divisional with Box 18 completed)
i. [ ] DELETION OF INVENTOR(S)
Signed statement attached deleting inventor(s) named in the prior application, see 37 CFR 1.63(d)(2) and 1.33(b).
6. [ ] Application Data Sheet. See 37 CFR 1.76
7. [ ] CD-ROM or CD-R in duplicate, large table or Computer Program *(Appendix)*
8. Nucleotide and/or Amino Acid Sequence Submission *(if applicable, all necessary)*
a. [ ] Computer Readable Form (CRF)
b. Specification Sequence Listing on:
i. [ ] CD-ROM or CD-R (2 copies); or
ii. [ ] paper
c. [ ] Statements verifying identity of above copies

ACCOMPANYING APPLICATIONS PARTS

9. [X] Assignment Papers (cover sheet & document(s))
10. [ ] 37 C.F.R.§3.73(b) Statement [X] Power of Attorney *(when there is an assignee)*
11. [ ] English Translation Document *(if applicable)*
12. [X] Information Disclosure Statement (IDS)/PTO-1449 [X] Copies of IDS Citations
13. [ ] Preliminary Amendment
14. [X] Return Receipt Postcard (MPEP 503) *(Should be specifically itemized)*
15. [ ] Certified Copy of Priority Document(s) *(if foreign priority is claimed)*
16. [X] Request and Certification under 35 U.S.C. 122 (b)(2)(B)(i). Applicant must attach form PTO/SB/35 or its equivalent.
17. [ ] Other: _____

18. If a CONTINUING APPLICATION, *check appropriate box, and supply the requisite information below and in a preliminary amendment, or in an Application Data Sheet under 37 CFR 1.76:*

[ ] Continuation [ ] Divisional [ ] Continuation-in-part (CIP) of prior application No: ____ / _____

Prior application information: *Examiner* ____ *Group / Art Unit:* _____

For CONTINUATION or DIVISIONAL APPS only: The entire disclosure of the prior application, from which an oath or declaration is supplied under Box 5b, is considered a part of the disclosure of the accompanying or divisional application and is hereby incorporated by reference. The incorporation can only be relied upon when a portion has been inadvertently omitted from the submitted application parts.

17. CORRESPONDENCE ADDRESS

[ ] *Customer Number or Bar Code Label* *(Insert Customer No. or Attach bar code label here)* or [X] *Correspondence address below*

Name	Robert C. Collins				
	Reising, Ethington, Barnes, Kisselle, Learman & McCulloch, P.C.				
Address	P.O. Box 4390				
City	Troy	State	MI	Zip Code	48099-4390
Country	US	Telephone	(248) 689-3500	Fax	(248) 689-4071

Name (Print/Type)	Robert C. Collins	Registration No. (Attorney/Agent)	27,430
Signature		Date	4/24/01

Burden Hour Statement: This form is estimated to take 0.2 hours to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Assistant Commissioner for Patents, Box Patent Application, Washington, DC 20231.

FEE TRANSMITTAL for FY 2001

Patent fees are subject to annual revision.

TOTAL AMOUNT OF PAYMENT ($) 750

Complete If Known	
Application Number	
Filing Date	Herewith
First Named Inventor	Gail M Cunningham
Examiner Name	
Group / Art Unit	
Attorney Docket No.	5196-01 FSP

METHOD OF PAYMENT (check one)

1. ☒ The Commissioner is hereby authorized to charge indicated fees and credit any over payments to:

Deposit Account Number: 50-0852

Deposit Account Name: Reising, Ethington, Barnes, Kisselle, Learman & McCulloch, PC

☒ Charge Any Additional Fee Required Under 37 CFR 1.16 and 1.17

☐ Applicant claims small entity status. See 37 CFR 1.27

2. ☒ Payment Enclosed:

☒ Check ☐ Credit card ☐ Money Order ☐ Other

FEE CALCULATION

1. BASIC FILING FEE

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
101	710	201	355	Utility filing fee	710
106	320	206	160	Design filing fee	
107	490	207	245	Plant filing fee	
108	710	208	355	Reissue filing fee	
114	150	214	75	Provisional filing fee	

SUBTOTAL (1) ($) 710

2. EXTRA CLAIM FEES

			Extra Claims		Fee from below	=	Fee Paid
Total Claims	7	-20**	0	X		=	0
Independent Claims	2	-3**	0	X		=	0
Multiple Dependent				X		=	0

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description
103	18	203	9	Claims in excess of 20
102	80	202	40	Independent claims in excess of 3
104	270	204	135	Multiple dependent claim, if not paid
109	80	209	40	** Reissue independent claims over original patent
110	18	210	9	** Reissue claims in excess of 20 and over original patent

SUBTOTAL (2) ($) 0

**or number previously paid, if greater; For Reissues, see above

FEE CALCULATION (continued)

3. ADDITIONAL FEES

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
105	130	205	65	Surcharge - late filing fee or oath	
127	50	227	25	Surcharge - late provisional filing fee or cover sheet.	
139	130	139	130	Non-English specification	
147	2,520	147	2,520	For filing a request for reexamination	
112	920*	112	920*	Requesting publication of SIR prior to Examiner action	
113	1,840*	113	1,840*	Requesting publication of SIR after Examiner action	
115	110	215	55	Extension for reply within first month	
116	390	216	195	Extension for reply within second month	
117	890	217	445	Extension for reply within third month	
118	1,390	218	695	Extension for reply within fourth month	
128	1,890	228	945	Extension for reply within fifth month	
119	310	219	155	Notice of Appeal	
120	310	220	155	Filing a brief in support of an appeal	
121	270	221	135	Request for oral hearing	
138	1,510	138	1,510	Petition to institute a public use proceeding	
140	110	240	55	Petition to revive – unavoidable	
141	1,240	241	620	Petition to revive – unintentional	
142	1,240	242	620	Utility issue fee (or reissue)	
143	440	243	220	Design issue fee	
144	600	244	300	Plant issue fee	
122	130	122	130	Petitions to the Commissioner	
123	130	123	130	Petitions related to provisional applications	
126	180	126	180	Submission of Information Disclosure Stmt	
581	40	581	40	Recording each patent assignment per property (times number of properties)	40
146	710	246	355	Filing a submission after final rejection (37 CFR § 1.129(a))	
149	710	249	355	For each additional invention to be examined (37 CFR § 1.129(b))	
179	710	279	355	Request for Continued Examination (RCE)	
169	900	169	900	Request for expedited examination of a design application	
				Other fee (specify)	

*Reduced by Basic Filing Fee Paid SUBTOTAL (3) ($) 40

SUBMITTED BY

Complete *(if applicable)*

Name (Print/Type)	Robert C. Collins	*Registration No. Attorney/Agent)*	27,430	*Telephone*	248-689-3500
Signature				*Date*	4/24/01

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

PTO/SB/35 (11-00)
Approved for use through 10/31/2002. OMB 0651-0031
U.S. Patent and Trademark Office; U. S. DEPARTMENT OF COMMERCE

REQUEST AND CERTIFICATION UNDER 35 U.S.C. 122(b)(2)(B)(i)	First Named Inventor	Gail M. Cunningham
	Title	Fluid Borne Noise Suppress.
	Atty Docket Number	5196-01 FCP

I hereby certify that the invention disclosed in the attached application **has not and will not be** the subject of an application filed in another country, or under a multilateral agreement, that requires publication at eighteen months after filing. I hereby request that the attached application not be published under 35 U.S.C. 122(b).

4/24/01
Date

Signature

Robert C. Collins
Typed or printed name

This request must be signed in compliance with 37 CFR 1.33(b) and submitted with the application **upon filing.**

Applicant may rescind this nonpublication request at any time. If applicant rescinds a request that an application not be published under 35 U.S.C. 122(b), the application will be scheduled for publication at eighteen months from the earliest claimed filing date for which a benefit is claimed.

If applicant subsequently files an application directed to the invention disclosed in the attached application in another country, or under a multilateral international agreement, that requires publication of applications eighteen months after filing, the applicant **must** notify the United States Patent and Trademark Office of such filing within forty-five (45) days after the date of the filing of such foreign or international application. **Failure to do so will result in abandonment of this application (35 U.S.C. 122(b)(2)(B)(iii)).**

Please type a plus sign (+) inside this box → [+]

PTO/SB/01 (10-00)
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U.S. Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE
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DECLARATION FOR UTILITY OR DESIGN PATENT APPLICATION (37 CFR 1.63)

☒ Declaration Submitted With Initial Filing OR ☐ Declaration Submitted after Initial Filing (surcharge (37 CFR 1.16 (e)) required)

Attorney Docket Number	5196-01 FSP
First Named Inventor	Gail M. Cunningham
COMPLETE IF KNOWN	
Application Number	/
Filing Date	Herewith
Group Art Unit	
Examiner Name	

As a below named inventor, I hereby declare that:

My residence, post office address, and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

Fluid-Borne Noise Suppression in an Automotive Power Steering System

(Title of the Invention)

the specification of which

☒ is attached hereto

OR

☐ was filed on (MM/DD/YYYY) ____ as United States Application Number or PCT International Application Number ____ and was amended on (MM/DD/YYYY) ____ (if applicable)

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims as amended specifically referred to above

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56, including for continuation-in-part applications, material information which became available between the filing date of the prior application and the national or PCT international filing date of the continuation-in-part application

I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or of any PCT international application having a filing date before that of the application on which priority is claimed

Prior Foreign Application Number(s)	Country	Foreign Filing Date (MM/DD/YYYY)	Country	Priority Not Claimed	Certified Copy Attached? YES	NO
				☐	☐	☐
				☐	☐	☐
				☐	☐	☐
				☐	☐	☐

☐ Additional foreign application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto

I hereby claim the benefit under 35 U.S.C. 119(e) of any United States provisional application(s) listed below.

Application Number(s)	Filing Date (MM/DD/YYYY)
60/200,122	04/27/2000

☐ Additional provisional application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto

Please type a plus sign (+) inside this box → [+]

PTO/SB/01 (10-00)

Approved for use through 10/31/2002. OMB 0651-0032

U.S. Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE

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DECLARATION — Utility or Design Patent Application

Direct all correspondence to: ☐ Customer Number or Bar Code Label	23388	OR ☐ Correspondence address below	
Name	Raising, Ethington, Barnes, Kisselle, Learman & McCulloch, PC		
Address	PO Box 4390		
Address			
City Troy	State Michigan	ZIP 48099-4390	
Country US	Telephone (248) 689-3500	Fax (248) 689-4071	

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

NAME OF SOLE OR FIRST INVENTOR	☐ A petition has been filed for this unsigned inventor		
Given Name (first and middle [if any]) Gail M.	Family Name or Surname Cunningham		
Inventor's Signature Gail M Cunningham		Date 4/23/01	
Residence: City Oxford	State MI	Country US	Citizenship US
Mailing Address 1149 Brookside Court			
Mailing Address			
City Oxford	State MI	ZIP 48371	Country US

NAME OF SECOND INVENTOR	☐ A petition has been filed for this unsigned inventor		
Given Name (first and middle [if any])	Family Name or Surname		
Inventor's Signature		Date	
Residence: City	State	Country	Citizenship
Mailing Address			
Mailing Address			
City	State	ZIP	Country

☐ Additional inventors are being named on the ____ supplemental Additional Inventor(s) sheet(s) PTO/SB/02A attached hereto

Please type a plus sign (+) inside this box →

PTO/SB/81 (10-00)
Approved for use through 10/31/2002 OMB 0651-0035
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

POWER OF ATTORNEY OR AUTHORIZATION OF AGENT

Application Number	
Filing Date	Herewith
First Named Inventor	Gail M. Cunningham
Group Art Unit	
Examiner Name	
Attorney Docket Number	

I hereby appoint.

☐ Practitioners at Customer Number 23389 → *Place Customer Number Bar Code Label here*

OR

☒ Practitioner(s) named below

Name	Registration Number
Robert C. Collins	27,430
William J. Waugaman	20,304
Robert M. Leonardi	27,815
Phillip A. Rotman II	38,290

as my/our attorney(s) or agent(s) to prosecute the application identified above, and to transact all business in the Patent and Trademark Office connected therewith.

Please change the correspondence address for the above-identified application to:

☐ The above-mentioned Customer Number.

OR

☒ Firm or Individual Name	Robert C. Collins				
Address	PO Box 4390				
Address					
City	Troy	State	Michigan	ZIP	48099-4390
Country	US				
Telephone	(248) 689-3500	Fax	(248) 689-4071		

I am the

☒ Applicant.

☐ Assignee of record of the entire interest. See 37 CFR 3.71.

Certificate under 37 CFR 3.73(b) is enclosed (Form PTO/SB/96)

SIGNATURE of Applicant or Assignee of Record

Name	Gail M. Cunningham
Signature	Gail M Cunningham
Date	4/20/01

NOTE: Signatures of all the inventors or assignees of record of the entire interest or their representative(s) are required. Submit multiple forms if more than one signature is required, see below*.

☐ *Total of ____ forms are submitted.

FORM PTO-1449 U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Use several sheets if necessary) (37 CFR 1.98(b))	ATTY. DOCKET NO. 5196-01 FSI	SERIAL NO.
	APPLICANT GAIL M. CUNNINGHAM	
	FILING DATE Herewith	GROUP

U.S. PATENT DOCUMENTS

EXAMINER INITIAL		PATENT NUMBER	ISSUE DATE	PATENTEE	CLASS	SUBCLASS	FILING DATE IF APPROPRIATE
		3 5 9 9 6 7 7	08/1971	O'Brien			
		3 6 0 5 8 1 8	09/1971	Balchan			
		3 9 4 8 2 9 3	04/1976	Bixby			
		4 0 3 5 5 3 4	07/1977	Nyberg			
		4 0 8 9 3 6 0	05/1978	Böhm			
		4 1 9 6 7 5 4	04/1980	Payne			
		4 2 8 7 2 1 7	09/1981	Hammer et al.			
		4 3 2 2 2 6 0	03/1982	Conlon			
		4 4 5 7 7 9 9	07/1984	Dunn			
		4 5 5 9 0 9 5	12/1985	Babbin			
		4 6 0 3 7 1 2	08/1986	Krause			
		4 6 3 3 9 1 2	02/2987	Pilkington et al.			
		4 6 5 7 2 8 5	04/1987	Akiyama et al.			
		4 6 8 8 6 0 5	08/1987	Eisenzimmer et al.			
		4 7 3 4 3 0 5	03/1988	Sugimoto et al.			
		4 8 7 0 9 9 5	10/1989	Igarashi et al.			
		4 9 9 8 5 6 5	03/1991	Kokuryu et al.			
		5 0 9 3 4 2 6	03/1992	Sakabe et al.			
		5 1 7 1 7 8 7	12/1992	Zama et al.			
		5 1 7 2 7 2 9	12/1992	Vantellini			
		5 2 0 1 3 4 3	04/1993	Zimmermann et al.			
		5 3 1 6 0 4 6	05/1994	Igarashi et al.			
		5 3 7 6 7 3 0	12/1994	Niwano et al.			
		5 5 2 1 3 4 0	05/1996	Thawani et al.			
		6 1 5 5 3 7 8	12/2000	Qatu et al.			

EXAMINER: Initial citation considered. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

FLUID-BORNE NOISE SUPPRESSION IN AN AUTOMOTIVE POWER STEERING SYSTEM

This application claims priority from Provisional Application Serial No. 60/200,122 filed April 27, 2000

The present invention is directed to suppression of fluid-borne noise in an automotive power steering system, and more particularly to a power steering pressure hose and method of manufacture having improved fluid-borne noise dampening characteristics.

Background of the Invention

Present day automobile power steering systems use power steering hoses that are constructed and/or provided with acoustic chambers and the like so as to, in varying degrees, dampen noise generated by the power steering pump and/or steering gear. The prior art is replete with a relatively long history of disclosures that describe devices incorporated inside the power steering hose or connected in line with the power steering hoses to dampen this noise. See for example U.S. Patent Nos. 5,521,340 and 5,172,729 and earlier patents cited as references therein. However, as to improvements in the construction of the power steering hose itself, the emphasis has been in the direction of developing improved heat resistance, which in turn should result in longer service life in the adverse automotive engine compartment environment. To achieve this, higher temperature materials such as chlorosulfonated polyethylene and hydrogenated nitrile have been used.

The power steering hose constructions usually consist of an annual laminate made up of a multiplicity of concentric tubular members, such as an innermost tube, a tubular reinforcement layer, a tubular friction layer, a second tubular reinforcement layer and a tubular outside cover layer. In some instances, the innermost tube of the hose itself is made up of two separate layers. These layers may be coextruded to provide a high temperature innermost material that would come in contact with the power steering fluid, backed up by a lower cost surrounding material to provide the necessary tube strength. See in this regard the U.S. Patent 5,316,046, issued May 31, 1994. See also U.S. Patent 4,998,565 and the prior art cited in the aforementioned '046 patent.

Summary of the Invention

In general, and by way of summary description and not by way of limitation, the present invention achieves the aforestated, as well as one or more additional objects set forth hereinafter, by providing a power steering hose construction that has improved noise dampening properties achieved by using a material for the innermost tube of the multilayer inner tube of the hose construction that has improved noise dampening properties, such as an ethylene/acrylic elastomer, without scarificing the resistance of the hose construction to high temperature fluid. This innermost tube preferably is bonded through vulcanization to a surrounding tube of material that possesses lesser noise dampening characteristics but provides other desirable physical characteristics in the composite hose construction. The dampening characteristics of the hose can be varied by varying the relationship of the radial wall thicknesses, relative to one another, of the inner and outer tubes of the multilayer innermost tube of the hose.

A method of dampening fluid-borne noise in an automotive power steering system in accordance with a presently preferred embodiment of the invention contemplates provision of a power steering fluid hose having a laminated inner tube surrounded by a reinforcing outer tube. The inner tube has a resilient inner layer with a radial thickness T_1 and a resilient outer layer with a radial thickness T_2. The inner layer is softer than the outer layer and is bonded by vulcanization to the outer layer. The radial thicknesses T_1 and T_2 have a ratio selected to dampen fluid-borne noise within a preselected frequency range by elastic expansion of the inner and outer layers.

Brief Description of the Drawings

The foregoing as well as additional objects, features and advantages of the present invention will become apparent from the following detailed description of the present invention taken in conjunction with the accompanying drawing wherein:

FIG. 1 is a schematic diagram of an automotive power steering system equipped with a power steering pressure hose in accordance with the present invention.

FIG. 2 is a fragmentary perspective view of a power steering hose construction embodying the hose construction features of the invention to provide improved noise dampening properties.

FIG. 3 is a cross sectional view taken on the line 2-2 of FIG. 1 but not to scale.

FIGS. 4-6 are graphs that illustrate test results in accordance with a presently preferred embodiment of the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 is a schematic diagram of an automotive power steering system 30. A pump 32 draws fluid from a sump 34 and delivers the fluid under pressure through a conduit 36 to a steering gear 38. From steering gear 38, the fluid is returned to sump 34 by a conduit 40.

Referring now to FIGS. 2 and 3 of the drawing, there is shown a power steering hose 10 constructed as an exemplary but presently preferred embodiment of the invention to serve as an improved conduit 36 and/or 40 (FIG. 1) for power steering fluid in automotive power steering system 30. Hose 10 includes multilayered inner tube 12 made up of an inner tubular layer 14 and an outer tubular layer 16, two concentric tubular braided reinforcement layers 18 and 20, and an outer tubular cover 22. If desired, an insulation rubber layer (not shown) may be disposed between the reinforcement layers 18 and 20, as illustrated in aforementioned U.S. Patent 5,316,046 (incorporated herein by reference). As best seen in the cross sectional view of FIG. 3, the wall thickness of inner layer 14 of tube 12 taken radially of the same is designated "T_1". Likewise, the wall thickness of the outer layer 16 of the multilayer inner tube 12 taken radially of the same is designated "T_2".

Instead of (or in addition to) attempting to provide sound deadening devices incorporated inside the hose or connected in line with the power steering hoses to dampen system noise generated by the power steering pump and/or steering gear, the present invention achieves noise dampening in the power steering hose by using a material for inner layer 14 of the multilayer tube 12 that has good noise dampening properties, such as an ethylene/acrylic elastomer, but without sacrificing the resistance of the hose construction to high temperature power steering fluid. Thus inner tube layer 14 is bonded through vulcanization to a surrounding material (described in more detail hereafter) used in the construction of the outer layer 16 of tube 12, which possesses lessor noise dampening characteristics but that can withstand high temperatures and thereby provides hoop strength reinforcement under such adverse temperature conditions.

In addition, the invention contemplates varying the noise dampening ability of hose 10 by adjusting the thickness T_1 of the inner layer 14 of tube 12 in relation to the thickness T_2 of the outer layer 16 of tube 12. The multilayer tube 12 may be made by a

coextrusion process and apparatus such as that disclosed in U.S. Patent 4,322,260 incorporated herein by reference. This multilayer inner core 12 may then be covered with the tubular reinforcement layers 18 and 20 in the form of a braid or spiral or woven material to provide reinforcement. The hose noise dampening ability can be enhanced further by using a reinforcement yarn in layers 18 and 20 such as nylon applied in such a manner as to allow for expansion of the hose under pressure. The expansion of the hose can be controlled through the amount of elongation of the yarn and the angle at which it is applied. See, for example, U.S. Patent 4,633,912 also incorporated herein by reference.

The hardness of the inner layer 14 of the multilayer inner tube 12 is preferably in approximately the range of 70-80 durometer. A durometer value below 70 may be too soft to obtain an adequate seal, whereas a durometer value above 80 renders it more difficult to manufacture the extruded layer and provides less noise dampening properties.

Outer layer 16 of inner tube 12 is preferably made of a peroxide-vulcanized acrylonitrile-butadiene copolymer rubber (NBR) that provides strength and high temperature resistance to the multilayer tube 12. Layers 14 and 16 of the multilayer tube 12 preferably are coextruded and bonded together through vulcanization after coextrusion. The two layers of braided material 18 and 20 provide hoop strength to the overall hose construction to achieve a burst pressure on the order of 8,000 to 10,000 psi and are preferably made of suitable synthetic fibers such as high elongation nylon. Outer cover 22 is preferably made of chlorinated polyethylene (CPE).

The ratio of the thickness T_1 of the inner layer 14 to the thickness T_2 of the outer layer 16 of the multilayer tube 12 preferably is selected at an empirically determined value in view of the desired noise dampening characteristics of hose 10 and the inside diameter of the multilayer inner tube 12. This empirical determination may be made by physical experimentation and/or analytical computer modeling. Hence, it is necessary that the minimum thickness for inner layer 14 be empirically determined to provide sufficient heat resistance and oil resistance, and more importantly the desired noise dampening characteristics. On the other hand, the outer layer 16 would have an empirically determined minimum thickness that would ensure sufficient adhesion to the inner layer 14 and to the reinforcement layer 18.

The ratio of T_1:T_2 is preferably approximately in the range of 30:70 to 70:30, with a preferred example being a mid-range ratio of 50:50. In any event the ratio can be further optimized and tuned to the particular vehicle power system to maximize noise dampening under the parameters of operation of a particular vehicle system.

FIGS. 4-6 are graphs that illustrate results of testing an automotive power steering hose in accordance with the present invention in comparison with currently available hoses for power steering applications. All hoses were 400 mm in length, and were tested in accordance with ISO 10767-1. Each graph of FIGS. 4-6 illustrate transmission loss TL (no units) as a function of frequency. The higher the transmission loss, the better the noise, vibration and harshness (NVH) characteristics of the hose. FIGS. 4 and 5 illustrate test results 50 for a hose in accordance with the present invention in comparison with various standard commercially available hose constructions. In each test, the hose in accordance with the present invention exhibited greatly superior dampening characteristics in the frequency range of about 300 to 400 Hz, which is the frequency range associated with "moan" of power steering systems.

FIG. 6 illustrates test results 50 of the hose in accordance with the present invention in comparison with commercially available hoses equipped with noise-suppression "tuners" of the type illustrated for example in US Patent 6,155,378. Once again, in the frequency range of about 300 to 400 Hz associated with objectionable "moan" noise in power steering systems, the hose in accordance with the present invention exhibited noise suppression properties superior to those of "tuned" hoses.

From the foregoing description it will be seen that high temperature and pressure power steering hose constructions have been in production for a number of years, and likewise that it is well known in the art to provide the capability to coextrude two different materials at the same time. The invention takes advantage of this prior knowledge in the art but improves upon it by employing two different materials and a selected ratio of respective laminate wall thicknesses in the innermost multilayer tube 12 of a multilaminate hose. Those two materials possess different degrees of noise dampening properties to help create the amount of noise dampening desired from the power steering hose and still maintain the high temperature fluid aging and fluid sealing properties required for prolonged service life of the hose in power steering automotive environments.

CLAIMS

1.

A method of dampening fluid-borne noise in an automotive power steering system which comprises directing power steering fluid through a power steering fluid hose having a laminated inner tube surrounded by a reinforcing outer tube, said inner tube having a resilient inner layer with a radial thickness T_1 and a resilient outer layer with a radial thickness T_2, said inner layer being softer than said outer layer and being bonded by vulcanization to said outer layer, said radial thicknesses T_1 and T_2 having a ratio selected to dampen fluid-borne noise within a preselected frequency range by elastic radial expansion of said inner and outer layers.

2.

The method set forth in claim 1 wherein said ratio is in the range of 30:70 to 70:30.

3.

The method set forth in claim 2 wherein said ration is 50:50.

4.

The method set forth in claim 1 wherein said inner layer has a hardness in the range of 70 to 80 diameter.

5.

The method set forth in claim 1 wherein said preselected frequency range is 300 to 400 Hz.

6.

The method set forth in claim 1 wherein said inner tube is of ethylene/acrylic elastomeric container, and said container tube is of peroxide-vulcanized acrylomitrile-butadiene copolymer.

7.

A method of making a power steering pressure hose having a predetermined fluid-borne noise dampening characteristics, which comprises the steps of:

(a) providing a laminated inner tube having an inner layer with a radial thickness T_1 and an outer layer with a radial thickness T_2, said inner layer having a hardness in the range of about 70 to 80 durometer, and said radial thickness T_1 having a ratio to said outer thickness T_2 in the range of about 30:70 to 70:30, and

(b) surrounding said inner tube with an outer reinforcing tube.

Abstract of the Disclosure

A method of dampening fluid-borne noise in an automotive power steering system in accordance with a presently preferred embodiment of the invention contemplates provision of a power steering fluid hose having a laminated inner tube surrounded by a reinforcing outer tube. The inner tube has a resilient inner layer with a radial thickness T_1 and a resilient outer layer with a radial thickness T_2. The inner layer is softer than the outer layer and is bonded by vulcanization to the outer layer. The radial thicknesses T_1 and T_2 have a ratio selected to dampen fluid-borne noise within a preselected frequency range by elastic expansion of the inner and outer layers.

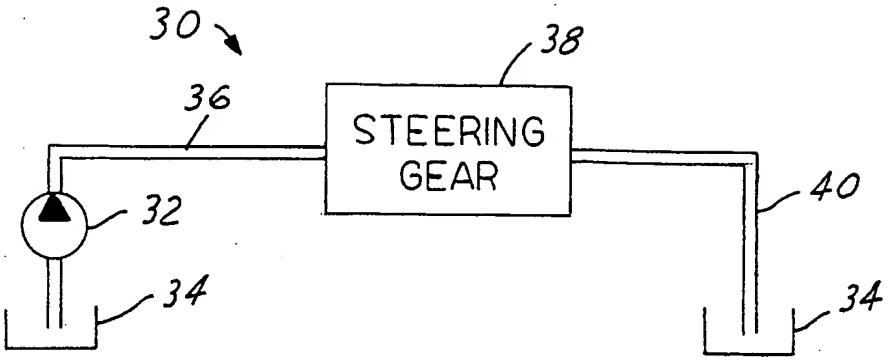

FIG. 1

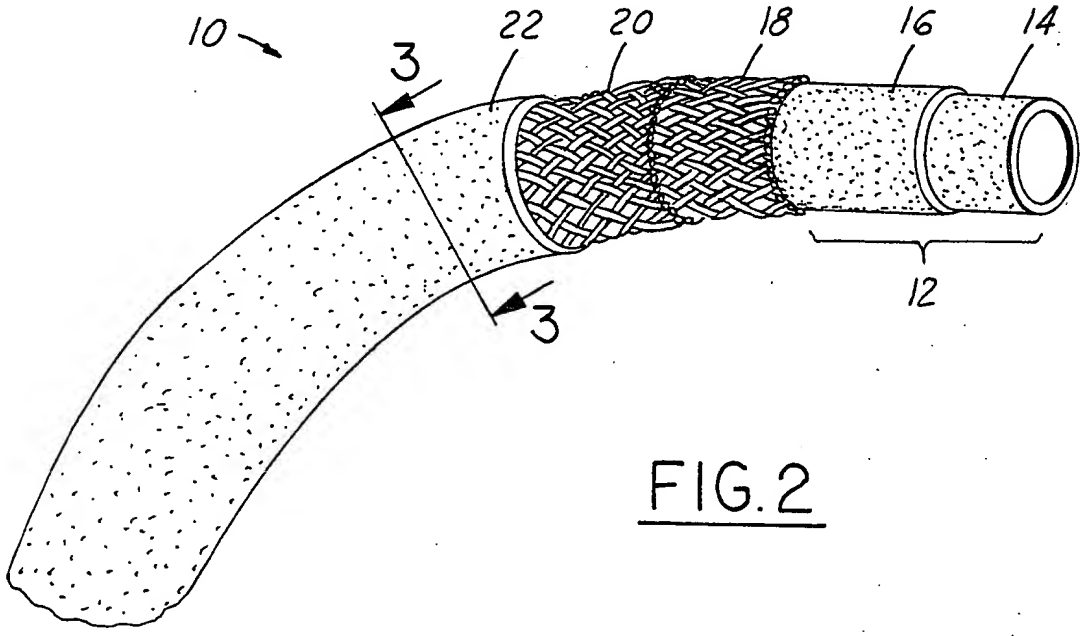

FIG. 2

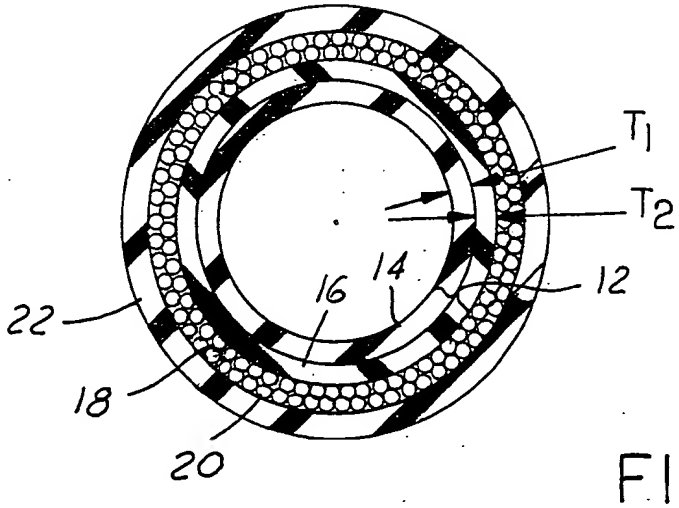

FIG. 3

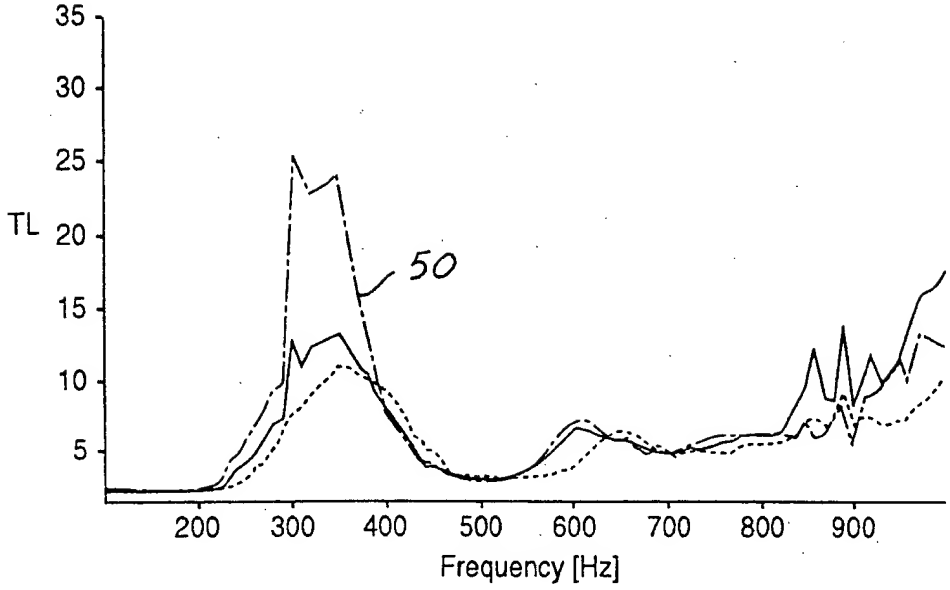
35
30
25
TL 20
15
10
5
50
200
300
400
500
600
700
800
900
Frequency [Hz]

FIG.4

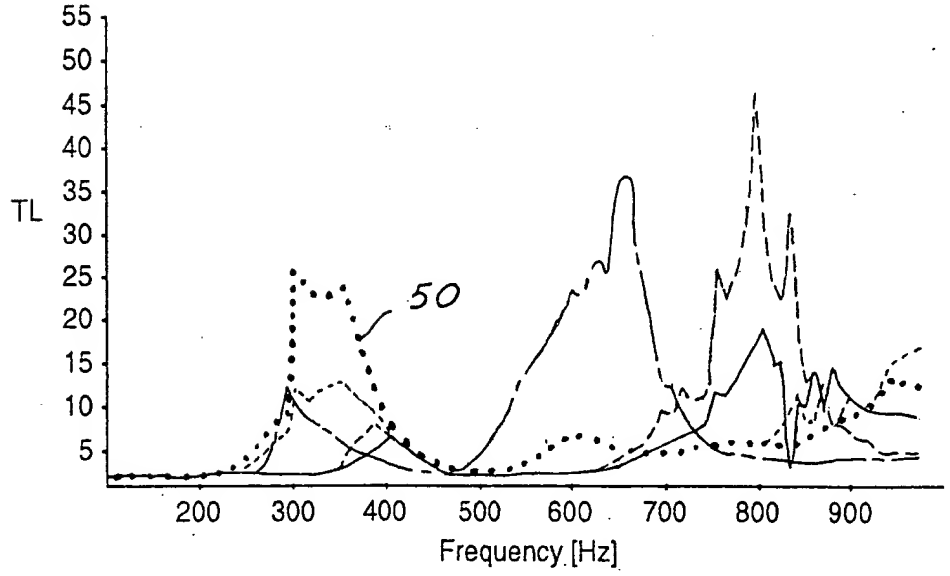
55
50
45
40
TL 35
30
25
20
15
10
5
50
200
300
400
500
600
700
800
900
Frequency [Hz]

FIG.5

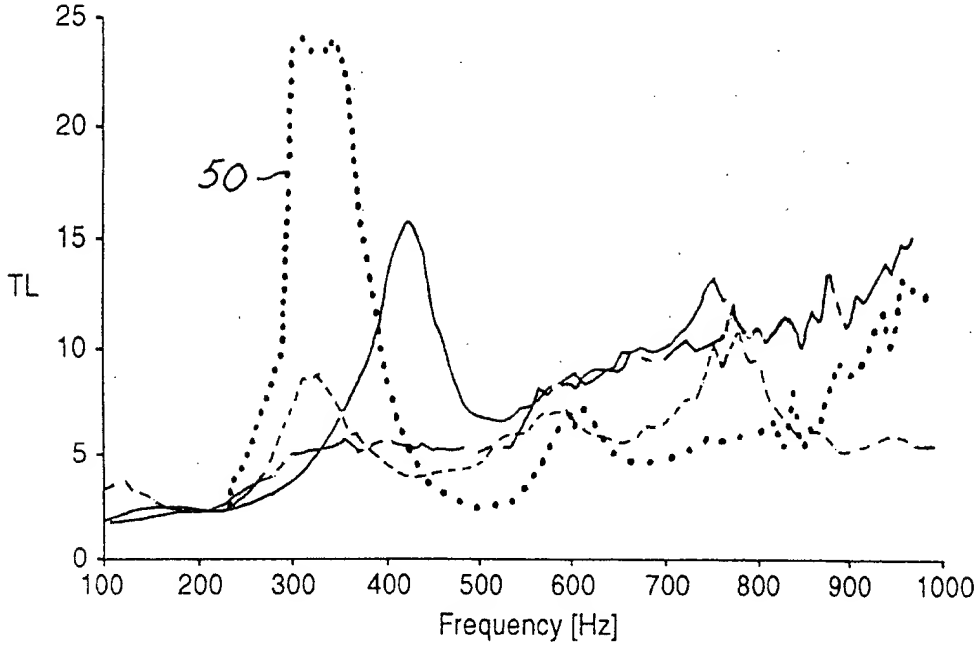
25
20
15
10
5
0
TL
50
100
200
300
400
500
600
700
800
900
1000
Frequency [Hz]

FIG.6

P4075

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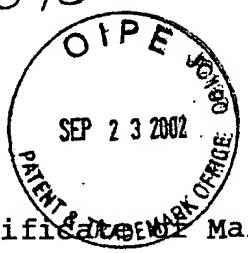

DESCRIPTION OF PAPER: Status Inquiry and Certificate of Mailing

NAME OF APPLICANT: Gail M. Cunningham

INTF. OR SERIAL NO.: 09/841,518

DATE: 09-16-02 ATTY.: RCC

Dana 5196-01

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APPLICATION NUMBER	FILING DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	DRAWINGS	TOT CLAIMS	IND CLAIMS
09/841,518	04/24/2001	1733	710	5196-01 FSP	3	7	2

CONFIRMATION NO. 5647

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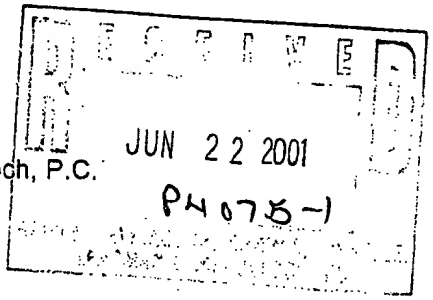

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Applicant(s)

Gail M. Cunningham, Oxford, MI;

Domestic Priority data as claimed by applicant

THIS APPLN CLAIMS BENEFIT OF 60/200,122 04/27/2000

Foreign Applications

If Required, Foreign Filing License Granted 06/15/2001

Projected Publication Date: Request for Non-Publication Acknowledged

Non-Publication Request: Yes

Early Publication Request: No

Title

Fluid-borne noise suppression in an automotive power steering system

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DESCRIPTION OF PAPER: UTILITY PAT. APP.

NAME OF APPLICANT: GAIL M. CUNNINGHAM

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FILED APRIL 27, 2000

DATE: 4/24/01 ATTY.: RCC

UTILITY App Tr; Fee Tr (in duplciate); Specification (8 pgs); 3 Sheets Drawings; Declaration (2 pgs); Power of Atty; Asmt. Papers (4 pgs); PTO 1449 and cited ref's. Req. & Cert under 35 USC122(b)(2)(B)(i); $750 to cover fees

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DESCRIPTION OF PAPER: UTILITY PAT. APP.

NAME OF APPLICANT: GAIL M. CUNNINGHAM

INTF. OR SERIAL NO.: BASED ON PROV. APP. SER. NO. 60/200,122
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UTILITY App Tr; Fee Tr (in duplciate); Specification (8 pgs); 3 Sheets Drawings; Declaration (2 pgs); Power of Atty; Asmt. Papers (4 pgs); PTO 1449 and cited ref's. Req. & Cert under 35 USC122(b)(2)(B)(i); $750 to cover fees

J1036 U.S. PTO
09/841518
04/24/01

2671.3047.002

04075-1

Docket Notes: Dana Corporation 5196 Date: April 29, 2004
Serial No. 09/841518
Action: Status Check

Action Taken: Status Inquiry/By Phone

Called PTO Office by Group Art# 1733. Called (571) 272-1215, spoke with Justin R. Fisher. He said he would place some calls to find out the status. But as far as he could tell it had not been docketed.

Justin R. Fisher called back said that he put a "LOST TAG" on the file. It means that they have flagged it for an extensive search. They are looking for the actual paper case filed. He could not give a time frame, but did suggest checking once a week on the PTO website to check the status.

Received another call from PTO, but from another agent, (571) 272-1212 Jeff Aftergut, he is the supervisor for Art Unit 1733. Justin R. Fisher referred him to me. He said the case was scanned as a image case (electronic case) but never got flagged as one. So it doesn't appear in the system as a image case (electronic case) but a paper case.

He reported to the individuals who are supposed to correct it to make it a electronic case and he also looked over the claims and it appears that it's appropriate for class 137 with Art Unit No. 3753. This Art Unit relates to fluid flow or fluid handling which is what the independent claim makes reference to.

The supervisor for Art Unit 3753 is David Scherbel. Mr. Aftergut suggests that I call him and see if he'll assign the case to someone over there. His number is (703) 308-1272.

Called Mr. Scherbel left message to call back. 4/29/04

Called Mr. Scherbel 5/10/04. He said that the case as of yet has not been assigned to anyone. A Transfer Request has been made for the case. He believes it is still marked as a paper case instead of an electronic case. Said to call back May 18th to check the status.

Called Mr. Scherbel 5/18/04. Mr. Scherbel says that case has not been transferred to his department. He thinks that it is still "Lost". He is going to contact Mr. Aftergut in Dept. 1733 to see if they have the paper case filed away someplace. Mr. Scherbel thinks that Mr. Aftergut believes the case was converted to an electronic case, but he believes it never was converted. Mr. Scherbel says he'll contact me to give the status of this case.

Called Mr. Scherbel 8/20/04 He says that he is not sure what is going on with this case, but he believes that the class unit was changed from 137 to 138. He will look into it.

Called Mr. Scherbel 10/26/04 Called Mr. Scherbel left voice mail message asking him to call back. Regarding status of 09/841,518

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Name of Applicant: Gail M. Cunningham

Serial No.: 09/841,518

Date: 10/29/04 **Attorney:** RCC/dc

Client Code: 5196-01 FSP (Dana 2671.3047.7002)

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Name of Applicant: Gail M. Cunningham

Serial No.: 09/841,518

Date: 10/29/04 **Attorney:** RCC/dc

Client Code: 5196-01 FSP (Dana 2671.3047.7002)